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DISTRIBUTION AND HABITAT ASSOCIATIONS OF THE MOUNTAIN PLOVER (*Charadrius montanus*) IN CALIFORNIA

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ABSTRACT: The mountain plover (*Charadrius montanus*) breeds in disturbed short-grass prairie or shrub semidesert habitats in the western Great Plains and winters in the southwest and western United States and Mexico. The number and distribution of wintering birds in California has decreased markedly since the 1800's. Loss of habitat in many states, and loss of habitat and changes in agricultural practices in California, have been implicated in population declines of over 60% from historic levels. The California Department of Fish and Game initiated a census of wintering mountain plovers in California employing skilled volunteers using standardized survey methods throughout the species historic California range. The 1998 survey resulted in detection of 2,663 birds at 31 sites in 11 California counties. The 1999 survey, which was less rigorous, resulted in detections of 1,372 birds at 10 sites in 3 counties. A similar one-day volunteer survey of historic mountain plover locations organized by the National Audubon Society in 1994 resulted in detection of an estimated 3,346 birds at 25 sites in 9 California counties. Mountain plovers selected barren, recently burned or grazed sites for foraging and roosting.

Key words: mountain plover, Charadriiformes, bird census, habitat associations

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California is a rapidly developing state with human population levels increasing from about 32 million currently to as much as 43 million by the year 2020 (U.S. Census Bureau 1999). Based on past trends (U.S. Census Bureau 1999), much of this growth will likely take place in California's Central Valley. Loss of habitat from conversion to agriculture and urban uses is expected to lead to the accelerated loss of Central Valley habitats including native and non-native grasslands.

Birds dependent on grassland habitats have experienced population declines in response to the continued loss of habitat and other factors. Native birds associated with grasslands have suffered steeper, more widespread, and more consistent declines over the past 25 years than any other bird group in the United States (Knopf 1994). One grassland species that has experienced historically steep population declines is the mountain plover (*Charadrius montanus*).

The mountain plover breeds east of the Rocky Mountains from Montana to New Mexico, western Texas and western Oklahoma south to central New Mexico. The main breeding areas are in northern Montana and in southeastern Colorado and Wyoming (USFWS 1999). The Pawnee National Grassland (Weld County, Colorado) is a stronghold for breeding mountain plovers with recent estimates of about 1,200 breeding birds (Graul and Webster 1976, Knopf and Rupert 1996). The species winters in central and southern California, southern Arizona, southern Texas, and northern Mexico with primary wintering

areas in the Central and Imperial valleys of California (Knopf 1996). Most post-breeding flocks of mountain plovers depart the breeding grounds in Colorado from mid-July to August (Knopf and Rupert 1996). Although occasional individuals or small groups arrive in California before September, the build up of wintering populations occurs from September through November. Wintering flocks depart California from February to mid-March and birds arrive on the Colorado breeding grounds in late March (Graul 1973).

The USFWS originally proposed the mountain plover for Federal listing as threatened on February 16, 1999 (USFWS 1999) and is currently preparing a formal proposal. In response to the need for additional distribution and habitat association information, we organized a statewide census of the species in 1998. In 1999, we attempted to organize volunteers to survey sites documented during the past efforts.

METHODS

Using data collected during a census organized and conducted by the National Audubon Society (NAS) in 1994, Audubon Christmas Bird Count (CBC) data, and anecdotal information from California Department of Fish and Game (CDFG) files and other CDFG sources, we identified historic winter roosting and foraging locations. We then created a standardized census form designed to record specific distribution and habitat-relationships information. Our objective was to 1) confirm and refine the

wintering distribution of the species in California, 2) confirm important (consistent use, abundance) wintering areas, and 3) identify habitat characteristics selected by wintering mountain plovers. We coordinated a mountain plover census in 1998 and 1999 using the NAS effort as a model for organizing and deploying skilled volunteers and our census was designed, for purposes of comparison, to collect some of the same information.

We solicited volunteers from professional birding and ornithological organizations, the NAS, and state and federal resource management agencies (e.g., CDFG, U.S. Fish and Wildlife Service). Volunteers were assigned a geographic survey area based on 1) proximity of surveyor to historic sites, 2) the number of volunteers in a given area or coordinated by an experienced surveyor in a given geographic region and, 3) state-wide coverage needs. Volunteers were supplied with field forms, a series of reduced (1:55812) United States Geological Survey (USGS) quadrangle maps covering their assigned area, and instructions for recording observational data. Volunteers were asked to record vegetation (habitat) type using the California Wildlife Habitats Relationship (CWHR) habitat classification system (Mayer and Laudenslayer 1988), dominant vegetation species (by cover), percentage vegetative cover, and plant height information for intensively surveyed vegetative units whether or not mountain plovers were observed. We asked volunteers to estimate these parameters and assign a value from among a series of provided values. Where data were adequate, we compared mean plant height and canopy cover between census years and between sites with and without reported mountain plover sightings using a chi-square test.

The census consisted of non-intensive searches for apparently suitable habitat and intensive searches within habitat types deemed suitable by the volunteer surveyor. Mountain plover habitat characteristics as described by Knopf and Rupert (1995), instructions for completing the census, and standardized census forms were provided to each volunteer participant. Observers were instructed to record observations on 24 January 1998 (1998 census) and 23 January (1999), although data recorded within 1 day of the census each year were accepted and included in the analysis. Despite the slight possibility of birds being counted more than once, we included these records to gain a more complete census coverage. A late January census date was selected to both coincide with the general time frame of the 1994 census and to maximize the possibility of observing wintering birds after fall migration but prior to staging for spring migration.

We attempted to further standardize the census by instructing volunteers to record the starting and ending times for both non-intensive and intensive census searches. In addition, volunteers were asked to provide a map indicating the census route and areas where they

conducted intensive searches. For the 1998 census, we calculated both the total census effort and the total area covered during the census. In this study, northern and southern California are distinguished by a line bisecting the state along the transverse range near the border of Kern and Ventura counties. An initial lack of funding for organizing the 1999 census resulted in delays in contacting volunteers and assigning routes, therefore 1999 data were insufficient to estimate census effort and area.

Observation points, survey routes, and areas of intensive searches from the 1998 and 1999 censuses were digitized and incorporated into a GIS. We assumed complete coverage of intensive survey areas, unless otherwise noted by observers, and, based on reported visibility, assumed a 402 m (0.25 mi) to 804 m (0.5 mi) search area along census routes. To aid in determining current and historic distribution and the relative importance of California to wintering mountain plovers, we obtained and compiled nationwide CBC data. Data were obtained from the USGS Biological Resource Division for the periods 1980 - 1989 and 1990 - 1997. These data are from the North American CBC in the United States and do not include CBC data from Mexico where mountain plovers are known to winter. The data were converted to a database format and records were compiled for each CBC count circle reporting mountain plover observations. CBC data were summarized by year and by count circle location and stored in a Geographic Information System (GIS) along with historic observational data and other mountain plover distribution information.

We developed a current California range map for mountain plovers by first projecting the CBC data, and other recent sighting data (Edson and Hunting 1999), against a California state and county map at 1:1,000,000 scale. To this base map we added ecoregion polygons (divisions) from the ecoregion classification system developed by the U.S. Department of Agriculture, Forest Service, Pacific Southwest Region (Miles and Goudy 1997). The polygons aided in our discrimination of gross vegetation changes. We selected this USDA system from among 5 existing bioregion or ecoregion maps because 1) it is based on measurable physical and biological attributes, and 2) it is a hierarchical system dividing the state into progressively smaller bio-geographical units allowing for analysis at several scales. The final base map layer was a coarse range map developed for the California Wildlife Habitat Relationship (CWHR) system (Zeiner et al. 1992).

Our approach to range map development followed an effort to depict range information for the California Department of Fish and Game bird species of special concern project (Comrack unpublished data, Garrison unpublished data). The approach is based on the use of spatial distribution and occurrence data in a systematic and hierarchical manner to model range based on information

from a variety of sources and scales (Hollander et al. 1994). The resulting range maps are limited by the quality of these data. We depicted the range by drawing maximum extent polygons on the base map. For purposes of this effort, we defined range as the maximum geographic area occupied by the species considering its opportunistic use of agricultural habitat, which exhibit considerable variation in temporal and spatial availability.

RESULTS

1998 Census

The 1998 census counted 2,663 birds at 31 sites in 11 California counties. Flock sizes ranged from 4 to 250 individuals (mean=85.6, median=90) with the largest flocks detected in Imperial (250) and Yolo (250) counties. The 1994 NAS census detected an estimated 3,346 birds at 25 sites in 9 California counties (National Audubon Society, unpublished data) with the largest flocks detected in Imperial county (1128 and 388 birds). The NAS survey involved 10 primary and an estimated 85 secondary observers. In both 1994 and 1998, about 80% of all birds were detected in southern California (Table 1). Surveyors covered approximately 34,110 ha (84,288 acres) during both intensive and non-intensive 1998 surveys. Approximately 115 observers logged about 220 total person hours of which 26.5 hours were spent conducting intensive surveys, or about 1.17 flock observations per intensive survey hour.

1999 Count

The 1999 count documented 1,372 birds at 10 of 21 historic sites in 3 California counties. Due to delayed funding and resulting late count organization, the 1999 count was not complete and contributed little to mountain plover distribution records. However, on 14 February 1999, ornithologists from the Point Reyes Bird Observatory (PRBO) and volunteers working with PRBO on a seabird census documented 2,486 birds at 13 sites in the Imperial Valley, Imperial County. This survey covered essentially all appropriate (e.g., burned, grazed) habitat in the Imperial Valley north of Interstate 8 (D. Shuford, unpublished data). All 1999 detections were in southern California.

Mountain Plover Distribution

Data collected during the censuses, as well as 1998 CBC data and anecdotal information from a variety of sources (Edson and Hunting 1999), indicate the mountain plover is generally distributed from Placer and Yolo Counties south along the western half of the San Joaquin Valley and in valleys in the coast range through Kern County (Figure 1). Along the coast, the species occurs irregularly along the south-central and southern coastal plain and, occasionally, in inland valleys. They occur in agricultural areas of the western Mojave and southern desert regions especially in the Imperial Valley and Salton Sea.

Analysis of CBC data from 1980 - 1997 indicates 85% of nationwide CBC counts reporting mountain plovers were in California and 95% of all birds detected in any year for all CBC count circles were in California during that period (Table 2). Both the number of birds observed and the number of CBC count circles reporting mountain plovers have decreased since 1980. Observations along the coast appear to exhibit the greatest decrease.

Habitat Associations and Behavior

The majority of mountain plover observations during all census years were in fallow fields, and 77% (1994), 85% (1998), and 63% (1999) of all plover observations were reported from fallow, grazed, and burned (barren) fields (Table 3). Plovers were observed on all surveyed burned sites and relatively few active agriculture and non-native grassland sites. Mountain plovers were observed on fallow, burned, and active agricultural sites more than other recorded vegetative cover and land use types and observed habitat associations were similar between census years. Estimated mean percentage canopy cover was not significantly different between 1994 and 1998 census years ($\chi^2=2.72$, $n=49$, $df=1$, $p>0.05$) or between 1998 observations with and without mountain plovers ($\chi^2=0.52$, $n=59$, $df=1$, $p>0.05$). Similarly, we found no significant difference ($\chi^2=0.009$, $n=46$, $df=1$, $p>0.05$) in reported mean plant height (Table 4) between 1994 and 1998, and no significant difference ($\chi^2=1.78$, $n=59$, $df=1$, $p>0.05$) between mean heights reported from 1998 observations with

Table 1. Mountain plover detections (percentage) during 1994, 1998, and 1999 census efforts in California.

| Region | 1994 | 1998 | 1999 |
|----------|------------|------------|-------------|
| Northern | 526 (17%) | 458 (21%) | 0 |
| Southern | 2531 (83%) | 1721 (79%) | 1372 (100%) |
| Total | 3057 | 2179 | 1372 |

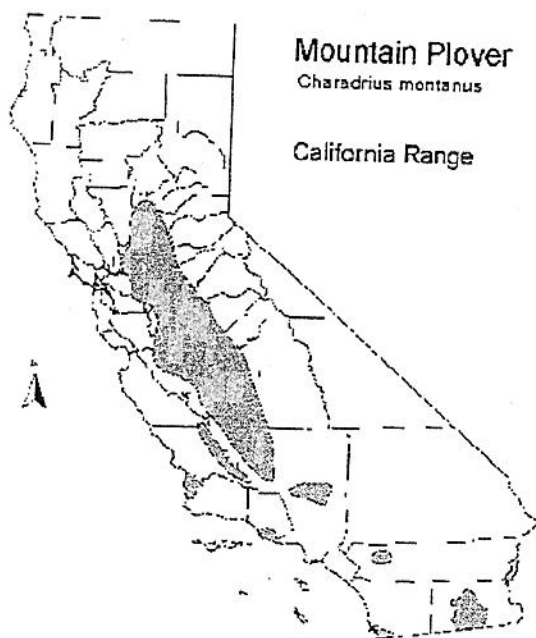


Figure 1. Range of the mountain plover (*Charadrius montanus*) in California (shaded polygons).

and without mountain plovers. In all years, most mountain plover flocks observed were foraging (Table 5).

DISCUSSION

Our results, combined with observations from others (Knopf and Rupert 1995, Knopf 1996) suggest a steep decline in North American populations of mountain plovers. Trend analysis from Christmas Bird Count data is not possible due to inherent limitations in data collection methods and the lack of sufficient detections in California count circles. However, our census results and the estimate provided by Knopf (1996), combined with information from breeding populations (Knowles and Knowles unpublished report, Sherman et al. unpublished report), substantiate the estimate by Sauer et al. (1997) of annual population declines of 2.7 % or the estimate by Knopf (1996) of a 3.7% annual decline. In California, the absolute loss of grassland habitats, although offset by cultivated agricultural lands, has likely been a major decline factor.

Observed foraging habitat associations by mountain plovers are consistent with characteristics reported by Knopf and Rupert (1995). However, surveyors were instructed to select areas for intensive searches based on characteristics previously reported in the literature, which may have biased habitat association results. Light conditions, survey time, and ability of participants to detect

Table 2. Christmas Bird Count data for the mountain plover, 1980-1997.

| CBC Survey Year | Calif./Total (%) count circles with detections | Calif./Total (%) Observed Birds |
|------------------|---|------------------------------------|
| 1980 | 11/12 (92%) | 554/558 (99%) |
| 1981 | 6/7 (86%) | 583/586 (99%) |
| 1982 | 7/9 (78%) | 629/631 (99%) |
| 1983 | 8/10 (80%) | 1004/1028 (98%) |
| 1984 | 7/8 (86%) | 917/931 (98%) |
| 1985 | 8/9 (89%) | 414/502 (82%) |
| 1986 | 7/9 (78%) | 599/605 (98%) |
| 1987 | 9/11 (82%) | 501/612 (82%) |
| 1988 | 6/7 (86%) | 1058/1114 (95%) |
| 1989 | 9/11 (82%) | 759/820 (93%) |
| 1990 | 4/7 (57%) | 337/462 (73%) |
| 1991 | 16/18 (88%) | 1237/1243 (99%) |
| 1992 | 7/7 (100%) | 193/193 (100%) |
| 1993 | 9/9 (100%) | 1146/1146 (100%) |
| 1994 | 6/6 (100%) | 319/319 (100%) |
| 1995 | 6/7 (86%) | 88/90 (97%) |
| 1996 | 4/5 (80%) | 214/215 (99%) |
| 1997 | 7/8 (88%) | 269/276 (97%) |
| Mean (\pm SD) | 0.85 (0.10) | 0.95 (0.08) |

birds in more vegetated areas may also have biased habitat association results.

The majority of observed mountain plover flocks during all census years were foraging. This result is predictable because most observations of plovers were made by surveyors selecting either known foraging sites, or sites exhibiting foraging site characteristics. The greater proportion of mountain plovers observed roosting during the 1994 census might have been due to late day surveys conducted in the Imperial Valley.

Historic CBC or 1994 census sites accounted for 100% of all 1998 observations despite intensive searches in pre-1985 historic sites exhibiting promising habitat characteristics. Volunteer surveyors reportedly covered all suitable habitat in the Coachella Valley (M. Patten, pers. comm.), Santa Maria River flood plain (R. Farris, pers. comm.), and San Jacinto Valley (C. McCaugh, pers. comm.) without detecting birds. A stratified random sampling approach within the known range of the mountain plover in California could yield habitat use and selection information.

Table 3. Number of habitat use observations (percentage) of mountain plovers on intensive survey sites with mountain plover observations during 1994, 1998, and 1999 censuses in California.

| Habitat | 1994 ¹ (n=22) | 1998 (n=30) | 1999 (n=11) |
|----------------------|--------------------------|-------------|-------------|
| Fallow | 9 (45%) | 15 (50%) | 3 (27%) |
| Grazed | -- | 7 (23%) | 1 (9%) |
| Burned | 7 (32%) | 4 (13%) | 3 (27%) |
| Non-Native Grassland | NC ¹ | 3 (10%) | -- |
| Active Agriculture | 3 (14%) | 1 (3%) | 1 (9%) |
| Natural Grassland | 1 (4.5%) | -- | -- |
| Other | 1 (4.5%) | -- | 3 (27%) |

¹ Habitat use data not collected.

Table 4. Estimated mean plant height (cm) and percentage vegetative cover on intensive mountain plover sites in California in 1994 and 1998.

| Variable | 1994 (n=18) | 1998 Sites with plovers (n=28) | 1998 Sites without plovers (n=31) |
|-------------------------------|-------------|---|--|
| Mean plant height (\pm SD) | 5.6 (1.97) | 5.1 (1.78) | 14.5 (17.7) |
| Mean % cover (\pm SD) | 47.8 (46.2) | 65.4 (38.5) | 57.5 (46.1) |

Table 5. Mountain plover behavior (percentage) observed during 1994, 1998, and 1999 surveys in California.

| Behaviors | 1994 (n=24) | 1998 (n=31) | 1999 (n=11) |
|-----------|-------------|-------------|-------------|
| Foraging | 17 (71%) | 28 (90%) | 10 (91%) |
| Roosting | 4 (17%) | 1 (3%) | 0 |
| Flying | 0 | 0 | 1 (9%) |
| Other | 3 (13%) | 1 (3%) | 0 |
| Unknown | 0 | 1 (3%) | 0 |

The map of the current range of the mountain plover in California incorporates occurrence, vegetation, and elevation data; factors presumed to strongly influence California distribution (Figure 1). The mountain plover is an opportunistic species adapted to habitat conditions that are spatially and temporally variable. Therefore, the map may be useful for conservation planning purposes and gross analyses, but should not be confused with actual species distribution. Future research efforts should focus on determining winter distribution and habitat use in other western states and habitat use and selection in California.

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